Uni-GraphLLM: Unified Graph Large Language Model for Multi-Domain Multi-Task Graph Alignment Instruction Tuning

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➢Motivation & Challenges

One shared graph encoder must align diverse graphs with the LLM token space across domains and tasks.

1. Generalizable, text-aligned representations

Structures, features and supervision vary across domains.
Task-specific GNNs lack textual-semantic guidance.

2. Uneven alignment difficulty

Graph data and instructions differ in how easily they align with the LLM. A fixed alignment strategy is suboptimal.

➢Two-stage Alignment

1. Graph-text pair pretraining

Label-free graph-text pairs train a multi-scale GraphSAGE encoder. Domain-aware contrastive weights emphasize negatives from semantically distant domains.

2. Curriculum alignment tuning

Projector gradient norms estimate domain difficulty.
Smoothed scores increase weights for harder domains.
Freeze the pretrained GNN and LLM. Train only the projector.

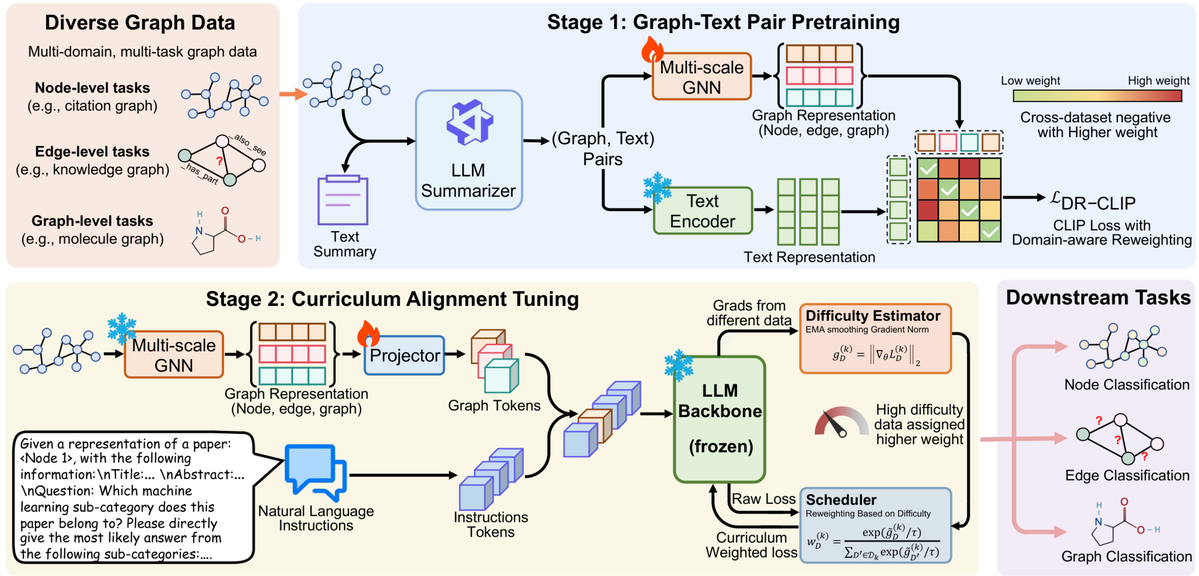
Cross-domain & Cross-task Transfer

Arxiv-only instruction tuning, then transfer to five datasets

ACC (%)	Cora	PubMed	Wiki-CS	WN18RR	FB15K237
Best baseline	43.33	51.14	40.11	22.65	16.93
Uni-GraphLLM	**55.17**	**77.31**	**63.93**	**24.12**	**55.27**

Encoder pretraining uses label-free data from all domains. FB15K237 uses 10-way candidates.

➢Uni-GraphLLM Framework



➢Experiments

Best on all 8 datasets against LLM baselines and SOTA GLMs

Dataset	Vicuna-7B	LLaMA-2-7B	GraphGPT	LLaGA	GOFA	TEA-GLM	Uni-GraphLLM
Cora	56.67	29.45	57.59	74.71	63.88	62.38	**76.98**
PubMed	78.92	25.36	73.45	68.54	64.72	85.13	**90.49**
Wiki-CS	62.34	22.22	49.20	69.16	66.77	55.19	**76.65**
Arxiv	43.75	6.33	67.63	73.83	66.11	66.81	**74.22**
WN18RR	34.84	29.16	N.S.	N.S.	21.95	92.85	**93.52**
FB15K237 (10-way)	56.01	20.60	N.S.	N.S.	54.41	91.85	**91.96**
ChemPCBA	46.47	51.12	N.S.	N.S.	60.61	80.40	**81.69**
ChemHIV	30.36	50.09	N.S.	N.S.	49.78	67.13	**70.09**
Mean score	**51.17**	**29.29**	**61.97†**	**71.56†**	**56.03**	**75.22**	**81.95**

Node/edge: ACC (%). Graph: ROC-AUC (%). N.S.: task not supported.
† GraphGPT/LLaGA means cover 4 node datasets. All other means cover 8 datasets.

github.com/haibo12/Uni-GraphLLM
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